Walking and Serum Cholesterol in Adults

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Abstract: We measured the association between walking for exercise and the ratio of total cholesterol/HDL cholesterol in 3,621 adults. After controlling for age, gender, income, body fat, alcohol use, exercise other than walking, and cigarette smoking, adults in the high, moderate, and low duration walking categories were compared to those in the no walking-no exercise category. The relative risk for total/HDL ratios of 5.0 or more were .46 (95% CI = .27, .80), .48 (95% CI = .30, .76), and 1.11 (95% CI = .81, 1.53) respectively. (*Am J Public Health* 1990; 80:1111–1113.)

Introduction

Although hypercholesterolemia is a key risk factor of cardiovascular disease,[1] its determinants, including physiologic, demographic and lifestyle factors, are less well established. Mounting evidence indicates that physical activity fosters favorable levels of serum cholesterol,[2–6] but findings have been inconsistent,[7–13] and many of the investigations have failed to control for the effects of alcohol use, body fat, tobacco use and other factors.

Despite the present-day enthusiasm for walking as a means of promoting health and fitness,[14,15] only two investigations have been conducted to determine the relation between walking and serum cholesterol,[10,16] and they have shown mixed results. Hence, the present study was conducted to assess the relation between walking for exercise and serum cholesterol, particularly the total cholesterol/high density lipoprotein cholesterol (HDL) ratio in 3,621 adult men and women. A secondary purpose was to ascertain the extent to which physiologic, demographic, and lifestyle factors confound the association.

Methods

Subjects

Subjects were employees of over 25 different companies that chose to participate in an ongoing health promotion/disease prevention screening program. Approximately 62 percent of the subjects were female, 85 percent were White, 69 percent were married, and 66 percent reported some college education. Mean age of the sample was 40.0 years (SD = 11.1) and the median gross family income was between $25,000–$30,000.

Approximately 14 percent of the employees elected not to participate in all of the health evaluations leaving a sample of 3,621 adults for the present investigation.

Instrumentation and Procedures

Registered nurses employed by Health Advancement Services, Inc., collected all of the data. Each subject was examined individually and privately for 60 minutes after participating in an orientation and completing an informed consent form. A structured questionnaire was used to collect demographic and lifestyle information. Weekly duration and frequency of walking for exercise was assessed as recommended by Stephens, *et al*,[17] but walking intensity was not measured. Total time spent exercising each week was also measured. A step test, the Kasch 3-minute Pulse Recovery Test,[18] assessed cardiovascular fitness. In the present study, as reported walking duration increased, physical fitness increased showing strong linear (Mantel-Haenszel: $\chi^2 = 48.0$, df = 1, $p = 0.0001$) and general associations ($\chi^2 = 87.5$, df = 18, $p = 0.0001$). Indirect validation of the total exercise time variable was demonstrated previously.[19]

Approximately 10 cc of blood was drawn from each subject and analyzed using the enzymatic method to determine serum cholesterol levels.[20] A Harpenden skinfold caliper was employed to assess subcutaneous fat at three body sites on each subject: for males, thigh, chest, abdomen; for females, iliac crest, triceps, thigh. The sum of the skinfold measurement along with age and gender were used to calculate the total body fat percentage of each subject.[21]

Data Analysis

Subjects were grouped into four categories according to their self-reported, weekly duration of walking for exercise and total exercise time:

- *None*: subjects reporting no weekly walking for exercise nor any regular exercise;
- *Low*: ½–2 hours of weekly walking for exercise;
- *Moderate*: 2½–4 hours of weekly exercise walking;
- *High*: 4½ hrs per week or more of exercise walking.

The total serum cholesterol/HDL ratio was calculated because the total/HDL ratio has greater heart disease predictive utility than the others used individually.[1] A total/HDL ratio of 5.0 or greater was used to signify high risk according to current recommendations.[22]

The relation between weekly walking duration and elevated total cholesterol/HDL ratios was measured by the odds ratio.[23] Subjects who reported no weekly walking for exercise nor any regular physical exercise were used as the reference group. Mantel-Haenszel summary risk estimates[24,25] were employed to control for the potential confounders: age, gender, income, body fat, alcohol use, cigarette smoking, and exercise other than walking. Analysis of covariance (ANCOVA) was used to determine mean total cholesterol, HDL-C and total/HDL cholesterol differences among the walking groups with the potential confounders controlled.

Results

Table 1 shows the relations between the control variables, walking duration, and the total cholesterol/HDL ratio. High walking duration was more common in those who were male, leaner, poorer, nonsmokers or light smokers, not heavy drinkers, those who performed little exercise other than walking, and those in their 20s or above 50 years of age. Those with elevated total/HDL ratios tended to be male,

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TABLE 1—Walking Duration and the Total/HDL-C Ratio According to the Control Variables

Control Variables	col%	Hours of Weekly Exercise Walking (row %)				Total/HDL ratio ≥5
		none[a]	½–2	2½–4	4½+	
Total Group	100	54.4	26.8	11.2	7.5	27.5
Age (years)						
19–29	19.4	49.8	29.8	11.9	8.5	17.0
30–39	32.2	53.7	30.0	8.8	7.6	25.4
40–49	26.8	60.0	22.4	12.2	5.4	30.2
50+	21.6	51.7	25.6	13.4	9.3	36.6
Gender						
male	38.1	53.4	25.3	11.0	10.3	44.8
female	61.9	55.1	27.8	11.4	5.8	14.2
Income (k)						
not reported	7.6	56.7	24.0	10.6	8.7	32.7
<15	9.7	50.4	22.6	14.6	12.3	23.7
16–24	17.5	58.2	24.5	10.3	7.1	26.1
25–44	36.8	55.7	26.2	11.1	7.1	28.0
45+	28.4	51.4	31.4	10.9	6.3	26.4
Body Fat						
lean	8.9	42.5	32.8	12.6	12.2	13.6
moderate	57.2	50.0	30.1	12.3	7.7	24.6
obese	33.9	59.5	23.4	9.8	7.3	39.0
Alcohol Use						
none/light	70.0	52.8	28.8	11.4	7.1	19.8
moderate	26.3	56.8	23.0	10.9	9.3	45.1
heavy	3.7	73.0	15.1	6.4	5.6	49.2
Exercise*						
none	83.8	80.2	8.4	6.8	4.6	27.4
½–2 hrs.	10.3	0.0	67.8	15.2	17.0	21.4
2–3½ hrs.	3.6	0.0	70.6	29.4	0.0	25.2
> 3½ hrs.	2.3	0.0	85.1	14.9	0.0	20.8
Smoking						
non/ex	80.2	52.8	28.8	11.4	7.0	25.0
1–20 daily	14.9	56.6	21.6	11.6	10.2	35.4
21 + daily	5.0	69.3	17.1	8.0	5.7	46.3

*"Exercise" included all exercise reported except walking.
[a]"None" (reference group), under the "Hours of Weekly Exercise Walking" heading included adults who did not walk for exercise or perform any other type of regular exercise.

older, fatter, smokers, drinkers, non-exercisers, and not poor.

Table 2 displays the prevalence of elevated total cholesterol/HDL ratios among the adults in the reference and walking categories, and estimated risk for each of the groups before and after adjustment for the potential confounders.

Table 3 shows the mean cholesterol differences among the four walking categories with the potential confounders controlled statistically (ANCOVA).

Discussion

The present findings indicate that adults who walk for exercise 2½–4 hours or more each week tend to have less than one-half the prevalence of elevated total cholesterol/HDL ratios (total/HDL ratio ≥ 5.0) as those who do not walk or exercise regularly.

There are a number of explanations as to why walking duration and the total/HDL ratios appear to be strongly related. High total cholesterol/HDL ratios may reflect problems that lead to decreased exercise-walking. Because subjects with elevated total/HDL ratios tend to be more obese and smoke more than their counterparts[1,26] and because obese adults and those who smoke tend to walk less than non-obese and non-smokers (findings of present study), adults with elevated ratios may choose not to walk as much as others. Elevated total cholesterol/HDL ratios and exercise-walking each may be caused by other common factors.

TABLE 2—Estimated Risk of Elevated Total/HDL Ratio by Weekly Walking Duration

Weekly Walking Duration	Variable Controlled	Elevated Total/HDL Ratio[a]			
		N	%	RR_{mh}	95% CI
None (n = 1,970)	none	583	29.6	1.00	—
½–2 hrs (n = 972)	none	233	24.0	0.75	0.63,0.89
	age, gender, ses, fat, alcohol, smoking, other exercise[b]			1.11	0.81,1.53
2½–4 hrs (n = 406)	none	90	22.2	0.68	0.53,0.87
	age, gender, ses, fat, alcohol, smoking, other exercise[b]			0.48	0.30,0.76
4½ hrs + (n = 273)	none	73	26.7	0.87	0.65,1.15
	age, gender, ses, fat, alcohol, smoking, other exercise[b]			0.46	0.27,0.80

NOTE: Subjects who reported no regular exercise walking or other exercise were used as the reference group.
[a]Elevated Total/HDL ratios were defined as those ratios ≥ 5.0.
[b]Other exercise included all exercise reported other than walking.

TABLE 3—Adjusted Mean Differences in Cholesterol among the Walking Groups

	Weekly Walking Duration							
	None		Low		Moderate		High	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total/HDL Ratio	4.81	1.6	4.70	1.4	4.49	1.3	4.53	1.6
Total-C (mmol/L)	5.34	1.1	5.28	1.0	5.19	1.1	5.19	1.1
HDL-C (mmol/L)	1.18	0.3	1.20	0.3	1.22	0.3	1.22	0.3

Means were adjusted for differences in age, gender, income, body fat, alcohol use, exercise other than walking, and cigarette smoking.

With the moderate and high duration walking groups combined and the covariates controlled, the following mean differences resulted (mmol/L):

Total/HDL ratio: None (M = 4.86) Moderate + High (M = 4.53), difference (.33); 95% confidence limits of the difference (.18, .46), $p < .05$

Total-C: None (M = 5.33) Moderate + High (M = 5.14), difference (0.19); 95% confidence limits of the difference (0.08, 0.29), $p < .05$

HDL-C: None (M = 1.17) Moderate + High (M = 1.21), difference (0.04); 95% confidence limits of the difference (0.01, 0.06), $p < .05$

Other potential confounders, particularly diet, could account for the inverse association between walking duration and elevated total/HDL ratios since research suggests that exercisers may consume different diets than non-exercisers,[27] and diet may be related to serum cholesterol levels.[1]

Finally, desirable total/HDL ratios may, in fact, result from moderate to high levels of exercise walking. Numerous studies confirm a connection between other types of aerobic exercise, besides walking, and favorable levels of serum cholesterol.[2–6]

Because subjects in the present study had relatively high socioeconomic status and education levels, generalization to poorer, less educated groups will necessitate further research.

Given the correlational design of this study, cause-and-effect conclusions are not warranted. However, if a causal relation is assumed, then at least 2½ to 4 hours of exercise walking per week should be practiced for protection against elevated total/HDL ratios. In the present study, ½ to 2 hours of weekly walking for exercise was not associated with decreased risk of high total/HDL ratios.

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